

RAPPORT CODEN: LUSADG/(SAPS-1017)/1-25/(1976)

Studies in G Analysis as Applied to Problems of Classification in Clinical Psychology and Psychiatry

Henrik Jonsson

1976



DISSERTATION SUMMARY
DECEMBER 1976

DEPARTMENT OF PSYCHOLOGY
LUND UNIVERSITY
PARADISGATAN 5
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Studies in G Analysis as Applied to Problems of
Classification in Clinical Psychology and Psychiatry

av

Henrik Jonsson

Fil. lic., Sm

A k a d e m i s k a v h a n d l i n g

som för avläggande av filcsofie doktors-
examen vid samhällsvetenskapliga fakul-
teten vid universitetet i Lund kommer
att offentligens försvaras i sal 104,
Lundagårdshuset, tisdagen den 7 december
1976 kl. 13.30.

Dokumentutgivare
04T0 Psykologiska institutionen
Lunds universitet
Handläggare
06T0
Författare
08T0 Henrik Jonsson

Dokumentnamn
04T4 Rapport
Utgivningsdatum
06T4 Dec 1976

Dokumentbeteckning
04T6 LUSADG/(SAPS-
1017)/1-25/(1976)
Ärendebeteckning
06T6 Doktorsavhand-
ling

10T4

Dokumenttitel och undertitel

18T0 Studies in G Analysis as Applied to Problems of Classification in Clinical Psychology and Psychiatry

Referat (sammandrag)

26T0

Rapporten är en sammanfattande inledning till en sammanläggningsavhandling baserad på fem artiklar (bilagor till rapporten). Samtliga artiklar har anknytning till G-analysmetoden, som är en inverterad faktoranalys där G-indexet (Holley, J.W. & Guilford, J.P. A note on the G index of agreement. Educ. psychol. Measmt., 24, 1964, 749-753.) används som mått på likhet mellan individernas svarsprofiler. I de två första artiklarna presenteras en empirisk undersökning av en grupp schizofrenipatienter och en normalgrupp. Syftet har här varit dels att använda metoden diskriminationsanalytiskt för att pröva den differentialdiagnostiska validiteten hos ett testbatteri, dels att undersöka schizofrenigruppens faktoriella heterogenitet. De nästföljande två artiklarna behandlar speciella metodproblem, medan den sista artikeln innehåller en sammanfattning av G-analysens grundläggande operationer samt data-program.

Referat skrivet av

42T0 förf

Förslag till ytterligare nyckelord

44T0 Inverterad faktoranalys. G-index. Psykiatrisk klassifikation. Differentialdiagnostisk validitet. Schizofrenikategorier.

Klassifikationssystem och -klass(er)

50T0 Psychometrics and Statistics. (Psychological Abstracts).

Indextermer (ange källa)

52T0 Factor Analysis. Clinical Psychology. Psychiatric Patients. Test Validity. Psychodiagnosis. (Subject index in Psychological Abstracts).

Omfång

56T0 25 sid.+5 bil.

Övriga bibliografiska uppgifter

56T2 Ingår i Psykologiska institutionens avhandlingsserie (Dissertation Series).

Språk

58T0 Engelska

Upplaga: 120 ex. med bilagor + 100 ex. utan bilagor.

Sekretessuppgifter

60T0

ISSN

60T4

ISBN

60T6

Dokumentet kan erhållas från

62T0 Lunds universitet, Psykologiska institutionen, Paradisgatan 5, 223 50 Lund

Mortagarens uppgifter

62T4

Pris

66T0

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The present dissertation is based on the following five papers, referred to in the text by the respective Roman numerals:

- I Jonsson, H. (1975). A factorial study of schizophrenia. Scand. J. Psychol., 16, 125-130.
- II Jonsson, H. & Franzén, G. (1976). Evaluation of some factor-analytically derived subclasses of schizophrenia. Psychol. Res. Bull., Lund Univ., 16, no. 1.
- III Jonsson, H. (1975). Isolation of clinical subclasses when series of population samples are analysed. Psychol. Res. Bull., Lund Univ., 15, no. 5.
- IV Holley, J.W. & Jonsson, H. (1974). On a proposed system for evaluating items in the method of G analysis. Psychol. Res. Bull., Lund Univ., 14, no. 8.
- V Holley, J.W., Robertsson, L., Jonsson, H., & Vegelius, J. (1975). Some basic equations and computer programs for G analysis. Psychol. Res. Bull., Lund Univ., 15, no. 6.

Study I and II which are closely connected - the second being a direct continuation of the first - are both empirical. These two studies should be considered as the most important part of the thesis. Study III and IV are rather loosely connected with the other studies. They are also loosely connected with each other, and should be viewed as distinct parts of a more extensive program for development of analytical methods. Study V, finally, contains a systematic presentation of the basic methods used in the three first studies. Computer programs for the described techniques are also provided.

The senior author is responsible for the planning and realization of study II, while the second author carried out psychi-

atric ratings, contributed to the psychiatric evaluation of the results and participated in the composition of the manuscript. Study IV is the product of a series of discussions between the authors. These discussions started some years before the paper was written, and have resulted in several tentative solutions to the problem at hand. The present one was presented by J.W. Holley, who also wrote the text of the paper. Study V, finally, is also a co-production, where the first author provided the equations and wrote the text. The second author constructed the computer programs, the third author provided the empirical demonstration and contributed to the development of some of the equations and the general model, and the forth author checked the computer programs and suggested some improvements.

Introduction

The present series of studies - each having its own object - have one thing in common; they are all parts of a large research project, the purpose of which is to develop and apply empirically a system of analytical methods. The constituent parts of this system are presented in study V. The starting-point is the G analysis¹ (Holley, 1973) - an inverted factor, or component analysis² where individuals constitute the variables which are analysed with respect to similarity of re-

¹ The term G analysis has been suggested by Holley (1973) in order not to confuse the present technique with analyses based on Stephenson's Q-sort (Stephenson, 1953), which group the persons but which, contrary to G analysis, cannot be converted to regular, or R, factor solutions - a requirement in the construction of diagnostic tests. Nevertheless, in studies I, II and III, labels like Q technique, Q analysis or Q factor analysis are interchangeably used instead of G analysis. These terms - which by most authors are used to denote inverted factor technique in general - might be adequate, however, if it is evident from the context that it is the analyses based on G indices that is meant.

² In the present series of papers, a consequent distinction

sponse profiles. The measure of similarity in this context is the G index of agreement (Holley and Guilford, 1964). The result of the analysis is a clustering of the individuals with respect to agreement of responses to a number of test items³ (preferably several hundred).

The G index and the G analysis were originally developed for dichotomous data (with arbitrary scoring directions), and almost all applications up to now have been based on such data (e. g. the empirical studies and the demonstrations of the present thesis). Yet, several generalizations of the G index have been attempted. The H index (Sjöberg and Holley, 1967) and the r_c index (Cohen, 1969) are two such attempts, which from a mathematical point of view are satisfactory (Vegelius, 1973). These indices, however, assume an interval scale - a requirement which almost never is fulfilled in clinical studies, where G analysis has its main application - and they have consequently been of little use. The G_o index (Holley and Kline, 1976a), the r_{OZ} index (Vegelius, 1976b) and the r_{BP} index (Vegelius, 1977a), on the other hand, are three recent alternatives which might be of practical importance in future research, since they can be used for ordinal scale data. A discussion on various G index generalizations can be found in Vegelius (1976a). The possibil-

between factor analysis and component analysis has not been made. Some authors (e.g. Harris, 1964; Mårdberg, 1969) reserve the term factor analysis for those cases where only the common variance of the data matrix is considered in the analysis. This is true of the analyses presented in studies II, III and V. In study I, on the other hand, the total variance has been analysed - a way of proceeding which according to some writers (e.g. Harris, 1964; Mårdberg, 1969) should be termed component analysis. This opinion, however, is not shared by e.g. Nunnally (1967), who thinks that factor analysis is an adequate term also in this case. The latter view is preferred by the present author.

³ Responses to test, or questionnaire items is the source of information most frequently employed. As a principle, however, any measurable person characteristics can be used.

ity to use the G analysis for non-dichotomized data is discussed in Vegelius (1977c).

G analysis has to date principally been used with two different purposes. In the one case the object has been to discriminate⁴ between a number of a priori defined groups - usually diagnostic groups in clinical psychiatry (e.g. Holley, Fröbärj, and Ekberg, 1965; Karlsson, 1971; Schubö, Hentschel, v. Zerssen, and Mombour, 1975; Hentschel, Schubö, and v. Zerssen, 1976), while the purpose in the other case has been to demonstrate the factorial heterogeneity of clinical groupings by explorative isolation of factors within these groupings; studies by Fröbärj and Holley (1968) and Hagberg (1971) like study II of the present thesis belong to this category. Yet the two purposes have sometimes been intimately tied together within one and the same study (e.g. Holley and Fröberj, 1967; Holley and Nilsson, 1973). The latter also applies to study I.

Irrespective of the specific purpose, G analysis also needs a placement system by which new samples of persons can be placed in reference to a certain factor solution or classification. If the research object is discrimination between specified diagnostic groups, it must be shown that the attained discrimination in the analysis group also stands when a validity group is tested. And later, when in such a manner, a respectable predictive validity has been achieved, the placement procedure might be used in the screening of new patients in the psychiatric clinic etc. In explorative studies, where the purpose is

⁴ The most commonly used method for discriminating between various groups has been multiple discriminant analysis (Anderson, 1958; Cooley and Lohnes, 1962; Mårdberg, 1969). This method, however, rests upon assumptions of multivariate normal distribution and is thus not suitable when clinical groups are used. Discrimination between groups usually implies an assessment of differential validity for items.

to arrive at useful classificatory principles in a domain, placement of new persons will similarly be a test of the extent to which the purpose has been attained. If a large percent of the persons can be adequately placed⁵, it may be regarded as more reasonable to assume that the classificatory system at hand is a good one.

The placement system most frequently used lately is based on the identification of each type in the analytical result with one of the G factors. The factors of the analysis are then used in describing the persons of the new sample - a procedure which results in a set of factor coordinates⁶ for these persons. Detailed accounts of the system, including the corresponding mathematical formula⁷, are presented in studies I, II, III and V, which are all based on this technique.

⁵

In studies I, II and III, the concept of validity has been used also in this case where no criteria of prediction are available. Validity in this context, however, rather refers to construct validity. A G factor in this case is a construct, the explanatory and classificatory usefulness of which is to be determined. This must be done by relating the construct to other constructs within the domain (psychiatric and psychological dimensions etc.). It must also be shown, however, that the construct in question explains a substantial part of the variance in equivalent new samples. The term verification, on the other hand, which has been used in some instances in study I, is clearly inappropriate in this context.

⁶

Terms like factor coordinates, estimated factor coordinates, estimated factor loadings etc., which all denote the same thing, have interchangeably been used in the different studies.

⁷

The formula, the present version of which was introduced by Holley and Risberg (1971), is adapted from earlier works of Dwyer (1937) - who gave the basic solution of the so-called extension analysis, and Mosier (1938, 1939) - who generalized the Dwyer solution. It should be noted that the formula is written in slightly different ways, with the use of slightly different symbols, in the four papers describing the technique. In principle, however, the same functional relationship is expressed.

It should also be mentioned, however, that alternative systems for placement have been described and employed. In the early applications of G analysis (Holley, Fröberj and Ekberg, 1965; Holley and Fröberj, 1967; Fröberj and Holley, 1968), representative items were selected for each factor. Persons were then assigned to the factorial groups on the basis of differential responses to these groups of items. A more refined method, which has been recommended by Holley (1973) because of its simplicity, is based on the Sandler (1963) system of "delegate analysis". A delegate is a hypothetical person representing a total score or a mean value on items for a number of persons selected to represent the factor. Persons who are to be placed are correlated, using a generalization of the G index, with the delegates. Placement is determined by the highest value for each person. A further elaboration of this technique has been presented by Holley and Kline (1976b), who use "delegate scores" as marker variables in a two-factor solution, the loadings of which provide for the placement of the new persons. A suggested rotational system where the marker variables are brought into proper alignment with the reference axes of the factors is of crucial importance in this context. A generalization of this system, so that it may be applied to models with more than two factors, has later been made by Meyer, Holley and Vegelius (1976). Still another system based on the use of "delegate scores" has recently been described (Vegelius, Holley and Jonsson, 1976). The latter, in which rotation is unnecessary, is based on the calculation of Euclidean distances between delegates and new persons.

Since the result of an inverted factor analysis is the grouping of persons, not tests, there has been controversy about the ways to identify and interpret the factors. Stephenson (1953), for instance, claims that the ultimate goal of inverted factor technique is the isolation of person factors, which cannot be

identified by other means than using reference persons in the analysis. Stephenson's conceptualization of inverted factor technique, however, is based on the use of measures which are originally ipsative. In G analysis, on the other hand, no such data requirement for the original scores is necessary, since the measures are "ipsatized" by the G index itself (Holley, 1964;1966) - a fact⁸ which allows for the use of the responses characteristic of the factor groupings as a meaningful basis for identifying and naming the factors (cf. Sandler, 1949; Holley, 1970; Holley and Harris, 1970). Tests can also be constructed for each factor.

If each type in the analytical result is identified with a G factor, the factor score matrix, containing reference values for test items, might be used in the selection of items descriptive of the factors. Since it has been found more practical, however, to select a number of persons to represent each factorial grouping, another technique has been preferred in most studies (i.a. studies I, II, III and V of the present thesis). Descriptive items are selected by means of a statistical index - the D estimate of discriminatory effectiveness (Holley and Risberg, 1972; Holley, 1973). A D estimate for an item with respect to a given category of persons is computed by taking the proportion of "plus" responses among the persons representing the category minus the proportion of "plus" responses among the persons not representing the category. This will give the index a range from -1 to +1. A detailed description of the D estimate is presented in study V.

⁸

This is also important from a practical point of view. When G analysis is applied, items from tests which have been administered in the usual manner can be employed directly - a procedure not possible with the Stephenson technique (Q-sort).

It should be pointed out, however, that a factor interpretation, by way of responses constituting the foundation of the factor analysis, ought to be completed by independent information about the factor representatives (age, sex, anamnestic data, course of illness, ratings of psychiatric status, diagnosis etc.).

Empirical studies

Study I and II were part of a research project where the testing of subjects was the result of a cooperative effort. Two initial explorative studies with a research object similar to that of study I were performed by Nilsson and Larsson (1972) and Holley and Nilsson (1973). These studies, which were based on a fewer number of subjects, gave results, which were reasonably consistent with the present findings. Part of the material of the present studies, finally, was used for other research purposes by Meyer (1973).

Study I was performed in order to investigate further the diagnostic usefulness of some test instruments in the study of schizophrenia. In the first place the differential diagnosis normal/schizophrenic was to be determined. In the second place the quality of the tests as a basis for meaningfully subgrouping the schizophrenics was to be evaluated.

The test instruments were intended to measure various aspects of the ego functions⁹ which were considered to be disturbed in schizophrenic subjects (Bellak, 1958; McChie and Chapman 1961, Chapman, 1966). Altogether 177 dichotomous¹⁰ items were used.

⁹

Notably autonomous ego functions like cognition, attention and perception.

¹⁰

A minority of the items were not naturally dichotomous and had to be dichotomized subsequently..

About half of these were taken from questionnaires (Gottfries, 1968a; 1968b; 1968c) covering various psychiatric symptoms (notably psychotic symptoms). The rest of the items came from the following test instruments: The metacontrast technique - MCT (Smith and Nyman, 1961; Smith, Johnson, Ljunghill-Andersson, and Almgren, 1970), The serial colour-word test - CWT (Smith and Klein, 1953; Smith and Nyman, 1972), The spiral aftereffect test - SAE (Andersson, Nilsson, Ruuth and Smith, 1972), The serial rod-and-frame test - RFT (Eberhard, 1964), Matrices 64 (Glissell, 1964), USTM-attention and USTM-synonyms (Prien, 1960). For a detailed discussion of the selected test methods as aids in the diagnosis of schizophrenia the reader is - along with the mentioned manuals and articles - referred to Jonsson (1973).

The subjects were 30 normals and 35 diagnosed schizophrenics newly admitted to the Department of Research, St. Lars Hospital, Lund. These subjects were assigned to two equivalent groups, one to be used as an analysis group and one as a cross-validation group (placement group).

The analytical methods described in the introduction were then applied (i.e. G analysis, placement of the cross-validation sample and factor interpretation¹¹).

An analysis according to the principal component method, rotating five factors (components), gave a structure with a clear-cut differentiation between normals, who belonged to the first factor (with the exception of two cases), and schizophrenics,

¹¹ By way of descriptive items and independent measures. Most important among the latter were diagnosis according to the WHO classification (WHO, 1967) and ratings of psychiatric mental status (Rockland and Pollin, 1965; Franzén, 1971).

who were distributed over the remaining four factors (with the exception of one case). The result of the cross-validation was extraordinarily successful considering the normal subjects, who one and all were placed in the first factor. The schizophrenics, on the other hand, had - with few exceptions - non-substantial factor coordinates in all factors. A respectable differential validity (normal/schizophrenic) could thus be demonstrated, while the status of the isolated schizophrenic subgroups - two of which could be meaningfully interpreted - seemed to be questionable.

Speculating as to the reasons why the selected items failed to give rise to stable schizophrenic subgroupings, different alternatives were considered. Since all the employed tests were previously documented as useful aids in the investigation of schizophrenic reactions, it should have been rash to reject them as inappropriate instruments in the grouping of schizophrenic patients. Nor were the chief analytical methods, which in numerous studies had proved their capacity in meaningfully clustering individuals, called in question. The principal component method of factoring¹², however, was considered somewhat disadvantageous in the present case. Using this method common and unique variance become partly mixed, which means that the factor groupings to some extent will be determined by the uniqueness of the subjects - a condition which will lower the probability of positive results in a cross-validation. The classical model of factor analysis¹² was thus suggested as a more appropriate alternative. The most prominent cause of the negative result, however, was probably to be sought in the very concept of schizophrenia. It is nowadays an accepted fact that this heterogeneous concept covers a multiplicity of reactions, which hardly can be brought together in a few dis-

¹²

Cf. note 2.

tinct syndromes. The sampling of individuals then becomes a crucial problem. If a positive result is to be achieved, persons with similar symptom patterns must be present in the analysis group as well as the placement group - a condition which might not be met when small samples of schizophrenic subjects are used. It was not considered urgent, however, to enlarge the analysis group, since the analysis in itself had resulted in at least two distinct factors of schizophrenia found to be descriptively relevant and related to independent diagnostic criteria. An enlargement of the placement group, on the other hand, was judged as an interesting possibility. It was thus considered worthwhile to continue the research efforts by a second study, the purpose of which should be a more thorough evaluation of the four subgroups of schizophrenia using the classical model of factor analysis¹³ and a larger placement sample.

As a first step a re-analysis was then performed on the same analysis group¹⁴ as used in study I. This new analysis brought about only few changes, the new factor solution being essentially identical to the old one. Factor coordinates were then computed for the placement group, which had been increased by 18 new schizophrenic subjects.¹⁵ With respect to factor I, the

¹³

Communalities were estimated according to the method of squared multiple correlations (without iterations).

¹⁴

It might be noticed that the analysis group still contained normal persons, despite the fact that the immediate purpose of study II was the analysis of differences between schizophrenics. This procedure was followed in order to remove the unsettling effect of those items which were relevant only with respect to the general difference between the two diagnostic groups.

¹⁵

The new placement group contained a total of 16 normals and 35 schizophrenics. The additional schizophrenics were selected and tested in the same way as the previous ones but at a later occasion.

result was in line with previous findings. All normals were placed in this factor, while only a few schizophrenics had coordinates of countable magnitude. Among the other factors, II and IV hardly gave rise to any substantial factor coordinates - a remarkable fact at least in the case of factor II, since this factor previously had been given a meaningful interpretation (paranoid schizophrenia) and besides had a strong position in the analysis group. Clearly positive findings, on the other hand, were reported for factor III and V - twelve schizophrenics being placed in the former and three in the latter factor.

A large majority of the subjects described by factor III had a formal diagnosis of latent schizophrenia (WHO, 1967). Psychiatric ratings (Rockland and Pollin, 1965; Franzén, 1971) of the factor representatives - though in most cases non-significantly different from those of the other schizophrenics - pointed in the same direction as this diagnosis. Descriptive items, finally, showed a syndrome of general disorientation (e.g. disturbance of perception, difficulty in concentrating on tasks, experience of losing control over thought processes, anxiety and pessimistic attitudes or anhedonia). Intellectual deficit and psychotic responses in personality tests, however, were less pronounced. Summing up the characteristics of factor III, the concepts of early schizophrenia in the sense of Chapman(1966) and non-regressive schizophrenia in the sense of Nyman¹⁶ (1975) - principally the latter - were discussed as final interpretations of the factor.

16

According to Nyman, the symptoms of non-regressive schizophrenia can be divided into four main headings: 1. Perceptual dishabituation of various modalities of mind, including experience of sensory inflow from stimuli; 2. Affective symptoms (anhedonia); 3. Anxiety; 4. Hypochondriasis. Most of the responses descriptive of factor III could be classified under the first three of these headings.

Factor V was judged as a more questionable construct. While it could tentatively be given a meaningful interpretation (almost recovered schizophrenics having an ideal pattern of adaption in the CWT), its classificatory value was limited.

The present writer would view the result of study II as generally positive, since it showed that the methodological model as well as the selected test instruments might well be used as important research tools in the shaping of classificatory principles in the domain of schizophrenia. The fact that some of the constructs failed in demonstrating explanatory power, however, was a cause of concern.

A model for coordinating factorial studies

If the value of a test battery is to be determined with respect to its capacity in meaningfully subgrouping individuals within a domain, it can be argued that ultimate conclusions can not be drawn from studies which - like the ones above - are based on a restricted number of subjects. What is to be judged as a sufficient number, of course, would be a matter of dispute and could be expected to vary depending on the clinical category being investigated. For an adequate number, however, several hundred would probably be required in the case of a complex and heterogeneous¹⁷ category like schizophrenia. To obtain such a large and representative sample, it should be apparent, would call for great resources and, for a single researcher, an enormous amount of time. For practical reasons, therefore, most researchers favour factorial studies with a more limited scope. Such studies, however, might still be valuable as steps towards the ultimate goal of covering a domain, if they can be coordinated with future research based on new subjects. An analytical

¹⁷

Cf. the discussion concerning this issue on pages 10 and 11.

model to be used in this context is presented, together with an empirical demonstration, in study III.

As already shown in study I and II, new persons can be added to get a further evaluation of a set of factor constructs previously isolated. This is done by computing factor coordinates for the persons in the new sample (placement group, validation group). Some factors then may explain a substantial part of the variance in the new sample, while others may not. Interpreting the constructs, finally, some may be judged as meaningful and practically useful, while others may not. Those which fulfil both conditions should be kept in future research, while different alternatives can be chosen for the others. Factors without "clinical meaning", however, would in most cases have to be rejected, while factors with such a meaning would preferably be retained until further notice.¹⁸

The total proportion of variance explained by the factors in the new sample is then computed. If this is considerably smaller than the corresponding proportion in the analysis group¹⁹ - something that is expected due to sampling differences - an analysis of the residual variance²⁰ might give rise to addi-

¹⁸ Taking study I as an example, the author would suggest the following strategy for future research in accordance with the model: Factor II, which was found to be a meaningful construct, is kept, since it might be expected to explain variance in a new sample of subjects. Factor III, naturally, is kept, while factor IV is rejected. Factor V, finally, is rejected due to lack of clinical usefulness.

¹⁹ Perspicuousness and simplicity being primarily aimed at, the demonstrational example of study III has unfortunately become somewhat misleading in this respect, the factors explaining almost as much variance in the second sample as in the first.

²⁰ Variance attributable to factors, which for some reason are rejected, might be regarded as residual and reanalysed together with this residual variance proper already at this stage.

tional meaningful G factors. This analysis, apart from being performed on a residual matrix for the second sample, should be done according to the same principles as applied initially. Factor coordinates will then be computed for the resulting new factors as well as the accepted (or tentatively accepted) factors of the original analysis using a third sample, the residual variance of which might form the basis for still additional factors etc.

It would be recommended that the analytical procedures be continued over as many steps as needed to establish a final set of meaningful and descriptively useful classificatory constructs.

A s y s t e m f o r e v a l u a t i n g i t e m s

As mentioned previously, one of the principal uses of G analysis is in the task of discriminating between groups, especially in the clinical field.²¹ Several successful attempts, including the one presented in study I, have been made using the technique for this purpose (Holley, Fröbärj, and Ekberg, 1965; Holley and Fröbärj, 1967; Karlsson, 1971; Holley and Nilsson, 1973; Schubö, Hentschel, v. Zerssen and Mombour, 1975²²; Hentschel, Schubö, and v. Zerssen, 1976). It is probable, however, that the accuracy of the analytical techniques would be further improved if items were selected by means of item analysis. In addition, different weights might be used for the various items, an item differentiating better between the groups being given a higher weight.

²¹

Cf. note 4.

²²

The paper by Hentschel and Schubö (1974) referred to in study IV is now superseded by Schubö, Hentschel, v. Zerssen, and Mombour (1975).

These problems have been addressed previously by the present author (Jonsson, 1973), but a mathematical solution was not offered in that context. Study IV, presents such a solution based on probability statistics. The model, which is confined to the two factor case where a choice is to be made between two relatively homogeneous categories, requires the use of the same number of persons in the two clinical groups comprising the analysis sample.²³ Generalization of the model is left for subsequent studies.

One objective of the method of item analysis presented is to determine the discriminatory level for clinical measures, in general, above which all items are "in agreement with respect to response and category" (i.e. when like-signed responses indicate, as most probable, like clinical categories), and below which none of the items are "in agreement with respect to response and category". This critical value, which is a function of the difference (d) in the total scores of the two groups for each item, is specified by $d = \frac{1}{2}\sqrt{N}$ (where N represents the total number of persons in the analysis sample). The critical value can also be expressed in terms of the previously mentioned D estimate of discriminatory effectiveness and will then be written $D = 1/\sqrt{N}$.

Still another objective of the presented model is to determine the probability (p_a) that like-signed responses to an item will indicate like clinical categories.²⁴ The p_a values might then be used to obtain item weights for those items

²³ The item evaluation would normally be based on the responses of the persons in the analysis group.

²⁴ The sentence at the bottom of page 4 in study IV should read: The probability, p_a , that like-signed responses to an item will indicate like^a clinical categories, then, would be given by ...

which have been selected according to the above principles - a procedure which will result in a set of weighted²⁵ G indices (G_w) between persons.

The idea of giving different weights to the test variables when inverted factor technique is used has also been discussed by Vegelius (1973; 1977b). Departing from the conceptualizations introduced in that context, two analytical techniques called "WHIDD-analysis" (Vegelius and Jonsson, 1976) and "weighted G analysis" (Vegelius and Jonsson, 1977) have recently been presented. In both cases item weights are determined by means of power functions. Each weight is an increasing function of the absolute value of the corresponding D estimate. These methods, which might be considered as alternative to the solution offered in study IV, have given promising results in pilot studies.

A m e t h o d o l o g i c a l a p p e n d i x .

Study V, which has been included in the present dissertation as a methodological appendix, presents the principal techniques used in studies I, II and III - i.e. inverse factor analysis using G indices, the placement technique and the D estimate of discriminatory effectiveness. Computer programs are also provided together with a demonstrational example.²⁶ Since all the described techniques already have been discussed in the introduction, they will not be further commented upon here.

C o n c l u d i n g r e m a r k s

With respect to the efforts of isolating clinically meaningful factor constructs within the category of schizophrenia (or any

²⁵

At the present moment the paper is being revised in this respect.

²⁶

The demonstrational example is identical to the one used in study III.

other defined psychiatric category), some notes of criticism would be in order. In this context, the empirical results of study I and II as well as the model of study III will be discussed.

Although the purpose of the research reported here was more modest, only being directed towards a shaping of classificatory constructs already in use, the explorative studies (I and II) and their hypothetical extension (represented by the model of study III) attempted to parallel the methodology of the R tradition in structuring a domain. The hypotheses concerning the schizophrenic subgroups, however, were admittedly vague, stating merely that a meaningful relation between factors and diagnostic criteria would occur. Starting with the two categories of schizophrenia and normals it was found that a rough separation of the two was possible. It was found too, however, that from among the four schizophrenic factors, essentially only one ("non-regressive" schizophrenia) was of potential clinical value. The present writer therefore would suspect that the simple procedure of grouping persons to comprise factor categories, unaided by supplementary techniques, would not be adequate. As a remedy for this inadequacy, the use of specific hypotheses with respect to subgroups, together with specific techniques for bringing out the hypothesized variance, would be suggested.

It might be mentioned in this connection that subsequent to the studies reported here, and partially as the result of their findings, delegate scores have been introduced as marker variables in the factorial procedures (Schubö, Hentschel, v. Zerssen and Mombour, 1975; Hentschel, Schubö and v. Zerssen, 1976; Meyer and Holley, 1976). In these studies classificatory consistency was achieved in the placement group using marker variables representing psychiatrically defined subgroups of schizophrenia.

Finally, it should be mentioned too, that the efforts to enhance the differential validity in the clinical field using G analysis and related techniques are currently being continued. In this connection some recent innovations might be cited (Fällström and Vegelius, 1976; Meyer and Holley, 1976; Meyer, Holley and Vegelius, 1976; Vegelius, Holley and Jonsson, 1976; Vegelius and Jonsson, 1976; Meyer and Holley, 1977; Vegelius and Jonsson, 1977). Among these contributions is a system for item weights which when applied to the data of study I resulted in a reported value of 97% placement accuracy (Vegelius and Jonsson, 1977).

A c k n o w l e d g e m e n t s

The present dissertation is a result of the cooperation between many persons. I am indebted to my supervisors Docent Jasper W. Holley and Professor Gudmund J.W. Smith, Department of Psychology, Lund University, for excellent advice, stimulating discussion and constructive criticism. The empirical studies of the dissertation were carried out at the Department of Research, St. Lars Hospital, Lund. I wish to thank Professor G. Eberhard Nyman and Fil. lic. Zvonimir Cesarec for placing the facilities of the department at my disposal. I also wish to thank my co-authors Docent Göran Franzén, Fil. kand. Leif Robertsson and Fil. dr Jan Vegelius, and my colleagues Fil. kand. Lennart Meyer and Fil.kand. Inga-Kersti Nilsson. I am also much obliged to Med. lic. Ingrid Gottfries and Mr Janos Muhi.

The scientific journal Scandinavian Journal of Psychology has kindly granted me permission to copy a published article. The studies of the dissertation were supported by grants from the Swedish Council for Social Science Research.

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